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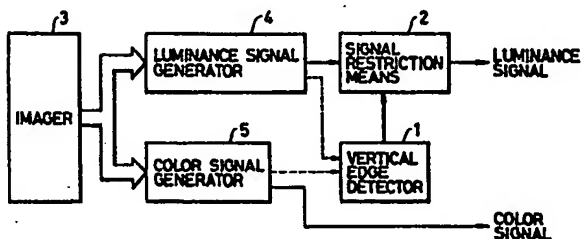
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Bulletin 86/10(72) Inventor: **Noda, Masaru**, 1-19, Fuzimigaoka Ninomiya-cho, Naka-Gun Kanagawa (JP)(84) Designated Contracting States: **DE FR GB**(74) Representative: **Altenburg, Udo, Dipl.-Phys. et al, Patent- und Rechtsanwälte Bardehle-Pagenberg-Dost-Altenburg-Frohwitter & Partner** Postfach 86 06 20, D-8000 München 86 (DE)

(64) Video signal processing circuit.

(57) In a video camera in which the video signals of two scanning lines adjacent with each other in vertical direction are read out simultaneously, the vertical edges in the video signal are detected (1) and, in response to the result of detection, the disturbance components arising at the vertical edge parts are eliminated (2).



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D e s c r i p t i o n

1 TITLE OF THE INVENTION

VIDEO SIGNAL PROCESSING CIRCUIT

BACKGROUND OF THE INVENTION

The present invention relates to a video signal  
5 processing circuit, especially to a video signal  
processing circuit appropriate to a video camera with a  
solid state imager.

Recently color video cameras with a solid state  
imager have been developed actively and as one  
10 representative example of them, "Solid State Color  
Camera with Single-Chip Mos Imager" described in  
Technical Report of the Institute of Television, Vol 4,  
No. 41, pp 1-6 (1981.Feb.) is known. The imager of  
this camera and its peripheral circuits are shown in  
15 Fig. 6. This imager consists of four kinds of picture  
elements that are the elements with all color  
transmission filters (W), with cyanic color transmission  
filters (Cy), with green color transmission filters (G)  
and with yellow color transmission filters (Ye). The  
20 horizontal pitch corresponds to 7.2 MHz in the frequency  
of the signal obtained by scanning of these elements.  
The method of scanning picture elements in such as that  
the vertical scanning are done for every two lines by  
the vertical scanning shiftregister 62 and the  
25 interlacing circuit 63, for example, the first scanning  
is done for the first and second lines, the second

1 scanning is for the third and fourth lines, the third  
scanning is for the fifth and sixth lines and so on.  
This is referred to the two line simultaneously read out  
method. The horizontal scanings are done by the  
5 horizontal scanning shiftregister 61 in 7.2 MHz in order  
of the arrangement of picture elements in horizontal  
direction. The luminance signal Y and two color signals  
R and B are obtained by addition and subtraction of  
four kinds of signals (these are referred to as W, Cy, G  
10 and Ye respectively) corresponding to each picture  
element as shown in the figure. Particularly, since the  
signal Y is obtained by addition of these four signals,  
the signal Y has a following property.

Observing the signal from the viewpoint of time  
15 series of horizontal scanning, the signals obtained from  
two kinds of picture elements adjacent in vertical  
direction are mixed such as  $(Y+G)$ ,  $(Cy+Ye)$ ,  $(G+W)$ ,  
 $(Ye+Cy)$ ,  $(W+G)$  and so on, and taken out in the frequency  
7.2MHz as outputs. Decomposing the above mentioned  
20  $(W+G)$  and  $(Cy+Ye)$  into the components of primary colors  
 $r, g$  and  $b$ , it can be understood that both of them  
consist of  $r+2g+b$ . This means that the sampling  
frequency of the signal Y in horizontal direction is  
7.2MHz and, in this imager, high resolution in  
25 horizontal direction equivalent to 3.6 MHz which is  
equal to the frequency in the monochromatic imager can  
be obtained. Such as this, the two lines simultaneously

1 read out method has such an advantage that, in spite of  
using many kinds of picture elements such as four, the  
fundamental sampling frequency for the signal Y can be  
retained to a short pitch which is equal to the minimum  
5 pitch of the picture elements and, due to this fact,  
high resolution can be attained.

Now, even in the imager by this two lines  
simultaneously read out method, when, for example, a  
picture having a pattern in which, as shown in Fig. 7,  
10 the boundary between a white part and a black part is  
sharp on the upper and lower sides of the picture is  
picked up into an image signal, there may be the case in  
which the effect of the two lines simultaneously read  
out method is not exhibited on the boundary and the  
15 carrier equivalent to 1.8MHz which is the half of the  
above arises. Due to this, in the picture displayed on  
a monitor screen, such phenomenon occur that, for  
example, lumpy light and shade are visible on the  
boundary, or the boundary is seen jaggedly. The reason  
20 is that, for example, in the case of said boundary being  
placed just in the middle of the two lines read out  
simultaneously such as in the middle of the first and  
second lines, even if the two lines are read out  
simultaneously, the reading out is essentially  
25 equivalent to scanning only one line which is  
illuminated by light since one of the two is not  
illuminated entirely or is illuminated dimly. As a  
result, the carrier which is determined by the

1 repetition period of the reading out of picture elements  
on one line arises, and in this case, the frequency  
component of the carrier equal to 1.8MHz arises since  
the level of each signal, that is W, Cy, G or Ye is  
5 different.

Also, an example using another imager by the two  
lines simultaneously read out method is shown in Fig. 8.  
Such an imager has three kinds of picture elements.  
W, Cy and Ye which are arranged with 1/2 pitch shift in  
10 every one line in order to obtain high horizontal  
resolution by reading out simultaneously two lines.  
Such an imaging device is shown, for example, in The  
Journal of the Institute of Television, Vol 37, No.10  
(1983.Oct.) pp.840-846. In Fig. 8, reference numeral  
15 81 denotes a horizontal scanning circuit for reading out  
the signal of each picture element sequentially in  
horizontal direction. This circuit corresponds to the  
horizontal scanning shiftregister 61 in Fig. 6.  
Reference numeral 83 designates a delay circuit for  
20 compensating the time shift which arises due to the  
simultaneous reading out of two picture elements shifted  
by 1/2 pitch with each other. After the signals  
delivered from three kinds of picture elements are  
separated by 2.4MHz sampling pulses having six phases in  
25 the sampling circuit 85, color signals are obtained by  
an operational processing.

Even in an image pickup device such as this, in the

1 case that a picture of the pattern shown in Fig. 7 is  
picked up into an image signal, and the boundary between  
a white part and a black part is placed in the middle of,  
for example, the first and second lines, the disturbance  
5 component whose frequency is 2.4MHz arises due to the  
same principle as mentioned above, and either "lump" or  
"jag" appears in this corresponding part of the picture  
displayed in a monitor TV screen.

#### 10 SUMMARY OF THE INVENTION

An object of the present invention is to overcome the  
defect of the conventional TV camera mentioned above and  
to provide a video signal processing circuit by which re-  
duction or no appearance of the "lump" or "jag" on the  
15 boundary can be attained even in the case that there is  
sharp boundaries between the upper and lower sides of a  
picture.

The above object can be accomplished by the present  
invention which provides a video signal processing circuit  
20 for a video camera in which the signals of picture elements  
arranged in the two lines adjacent with each other in ver-  
tical direction on an imager are read out during the same  
horizontal scanning period, comprising: detection means  
for detecting the vertical edge in a video signal obtained  
25 by the imager; and signal restriction means which is ar-  
ranged in the path of the luminance signal and suppresses  
the passing of the signal components in a predetermined

1 frequency band in response to the output of the detecting  
means only when the vertical edge is detected by the de-  
tection means.

## 5 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an embodiment of  
the present invention. Figs. 2A, 2B and 2C are circuit  
diagrams showing examples of concrete circuits of the  
signal restriction means for use in the embodiment of the  
10 present invention. Figs. 3A, 3B and 3C are the charac-  
teristic curves of these circuits for explaining their  
performance. Fig. 4 is a block diagram showing one ex-  
ample of the vertical edge detection means for use in the  
embodiment of the present invention. Fig. 5 is an illus-  
15 tration for explaining performance of the vertical edge  
detection means. Fig. 6 is a block diagram showing an ex-  
ample of the imager to which the two lines simultaneously  
read out method is applied, and its peripheral circuits.  
Fig. 7 is an illustrative view for explaining one example  
20 of a pattern imaged. Fig. 8 is a block diagram showing  
another imager wherein the two lines simultaneously read  
out method is used, and its peripheral circuit.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

25 Fig. 1 is a block diagram showing an embodiment of  
the present invention. Reference numeral 3 denotes an  
imager, 4 a luminance signals generating circuit for

1 generating luminance signals from the output of the  
imager 3, and 5 a color signal generating circuit for  
generating color signals also from the output of the  
imager 3. These circuits are similar to the circuits  
5 shown either in Fig. 6 or in Fig. 8. Reference numeral  
1 designates a vertical edge detection means for detec-  
ting the existence of edges in vertical direction of a  
picture and reference numeral 2 denotes a signal restri-  
ction means for suppressing or limiting the passing of  
10 signals whose frequencies are in a predetermined range  
including the frequency of the above mentioned disturb-  
ance component or higher than that of the disturbance  
component. These two means are the distinctive means  
in the present invention. The signal restriction means 2,  
15 fundamentally, consists of a filter for suppressing  
signals whose frequencies are in a specific range and  
is controlled to have a characteristic of a filter or  
to pass essentially all signals regardless of their fre-  
quencies by a control signal. Accordingly, the perform-  
20 ance is so controlled by the output of the vertical edge  
detection means 1 that the signals whose frequencies are  
in a specific band or are equal to and higher than a  
specific frequency is prevented from passing therethrough  
when the vertical edge is detected and the suppress of  
25 the passing ceases when the vertical edge is not detected.

The examples of the concrete construction of such  
means are explained referring to Figs. 2A to 2C and



1 Figs. 3A to 3C. In Figs. 2A to 2C, reference numeral 21  
denotes a terminal to which output signal to the lumi-  
nance signal generating circuit 4 is applied and the out-  
put signal is obtained at the terminal 22. The output  
5 signal of the vertical edge detection means 1 is applied  
to the terminal 23.

The circuit shown in Fig. 2A is a band suppress  
filter for suppressing selectively the passing of signals  
whose frequencies are in a specific range including the  
10 frequency of the disturbance component. When high level  
voltage is applied to the terminal 23, the transistor 25  
is turned ON and the LC serial resonance circuit 24 forms  
a resonance trap and, as a result, the frequency charac-  
teristic as shown in Fig. 3A is obtained. This trap fre-  
15 quency is selected to 1.8MHz in the case of such imager  
as shown in Fig. 6, and is selected to 2.4MHz in the case  
of such imager as shown in Fig. 8. In the circuit shown  
in Fig. 2A, since it is possible to pass signals whose fre-  
quencies are higher than the trap frequency even in the case  
20 that the trap is in function, the deterioration of the ver-  
tical resolution can be minimized even in the part of the  
vertical edge.

The circuit shown in Fig. 2B is a circuit for sup-  
pressing the passing of signals whose frequencies are  
25 higher than the frequency of the disturbance component  
and this circuit gives the characteristic of a low pass  
filter owing to the capacitor 26 functioned by turnning

1 transistor 25 ON. The special feature of this circuit  
is its simplicity of the construction, but there is such  
a problem that it is difficult to obtain enough ability  
of suppressing of signals in the frequency of the dis-  
5 turbance component (in this case, it is 1.8MHz) as the  
frequency characteristic shown in Fig. 3B.

The circuit shown in Fig. 2C is one example of cir-  
cuits by which the passing of signals whose frequencies  
are equal to and higher than that of the disturbance com-  
10 ponent can be suppressed enough. This circuit separates  
the input signal to low and high frequency components by  
the low pass filter 27 and the high pass filter 28 re-  
spectively and controls the passing of high frequency  
components including the frequency of the disturbance  
15 component by the ON-OFF of the analog gate 29. As is  
shown in Fig. 3C, better effect of suppressing of the  
disturbance than that shown in Fig. 3B can be obtained  
by the selection of the cut-off characteristics of the  
low pass filter 27 and the high pass filter 28.

20 The examples shown in Figs. 3A to 3C are the char-  
acteristics of these circuits which are applied to the  
case that the frequency of the disturbance component is  
1.8MHz and, since the frequency of the disturbance com-  
ponent varies when the arrangement of picture elements  
25 of the imager is changed, it is necessary to change the  
setting of frequency in these circuits according to the  
imager used. For example, in the case of using such

1 imager as shown in Fig. 8, the frequency is set to 2.4MHz  
as above mentioned.

In the next, an example of the concrete construction  
of the vertical edge detection means 1 is shown in Fig. 4  
5 and its performance is explained in Fig. 5. In Fig. 4,  
reference numeral 11 designates an input terminal for the  
video signal, 12 an output terminal for the detected  
signal of the existence of the vertical edge, 13 a delay  
circuit with the delay time equal to one horizontal scan-  
10 ning period (1H), and 14 an absolute value circuit con-  
sisting of, for example, a full-wave rectifier.

It has been well known that the vertical edge signal  
is extracted by subtracting the signal delayed for the  
time 1H from the signal not delayed. Fig. 5 shows signal  
15 waveforms corresponding to the illustrated image pattern  
of white, black and gray colors. In this figure, symbol  
a denotes a waveform of the video signal appearing at the  
terminal 11, which is shown corresponding to the image  
pattern, b designates a waveform of the output of the  
20 subtracting operation, which becomes pulse signal whose  
polarity is opposite according to the direction of the  
variation of the luminance at a boundary. By letting  
this signal pass through the absolute value circuit 14,  
the signal C corresponding to a sharp boundary between  
25 the upper and lower parts of a picture, that is to a  
vertical edge part is obtained at the terminal 12.  
Since the passing of the disturbance component arising

1 at the vertical edge can be suppressed by applying this  
signal C to the control signal terminal 23 in the signal  
restriction means 2, it is possible to eliminate the  
disturbance.

5       The luminance signal is generally proper as the  
video signal applied to the input terminal 11 of the cir-  
cuit shown in Fig. 4, but it is possible to use color  
signals such as red (R), green (G), and blue (B) color  
signals and further it is possible to use color difference  
10 signals such as (R-Y), (B-Y), and so on. In such cases,  
characteristic detections of the vertical edge are possible  
respectively. For example, not in the case of the pattern  
colored as shown in Fig. 7 but in the case of a pattern  
colored by magenta and green colors adjacent with each  
15 other at the upper and lower sides of a picture, the ver-  
tical edge can not be detected well by these luminance  
signals since the difference of these luminance levels is  
small, but if the color difference signal is used, the  
vertical edge of such case as above mentioned can be de-  
20 tected sharply since (R-Y) varies largely from positive  
to negative at the boundary of two colors. Accordingly,  
by providing a circuit for detecting vertical edges using  
color signals in addition to the vertical edge detection  
circuit using luminance signals and making the signal re-  
25 striction means operative when at least one of the two  
circuits detects a vertical edge, it becomes more effec-  
tive to eliminate the disturbance.

1        In the next, another concrete example of the vertical edge detection means will be explained without figures. In this example, a vertical edge is detected by subtracting the signal of one line from the signal of  
5 the other line obtained from the imager by the two lines simultaneously read out method as shown in Fig. 6 and Fig. 8. However, in the case of the imager shown in Fig. 6, since signals delivered from two lines are given to each signal line of W, Ye, Cy and G alternately, these signals must  
10 be separated to the signal corresponding to each by sampling. The detail of the technique for detecting a vertical edge directly such as this from the output of an imager is described, for example, in the official gazette of Japanese Patent Application Laid-Open No. 143675/1983 and it can be  
15 used for the present invention.

As above mentioned, according to the present invention, the disturbance showing "lump" or "jag" at the boundary arising when a object having a sharp boundary of a pattern between the upper and lower sides is picked up  
20 by an imager wherein the two lines simultaneously read out method is applied thereto, can be eliminated or reduced and the quality of pictures can be improved largely.

And since the suppressing filter for suppressing or restricting the passing of signals operates to suppress  
25 the passing of signals only when said boundary part between the upper and lower sides is scanned, the passing

1 frequency of the luminance signals is not varied except  
on this boundary part and as a result, the deterioration  
of the horizontal resolution does not occur except on  
the boundary part.

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C l a i m s

1     1. A video signal processing circuit for a video  
camera in which the signals of picture elements arranged  
in the two lines adjacent with each other in vertical dir-  
ection on an imager are read out during the same horizontal  
5 scanning period, comprising:

detection means for detecting the vertical edge in  
a video signal obtained by the imager; and

a signal restriction means which is arranged in the  
path of the luminance signal and suppresses the passing of  
10 the signal components in a predetermined frequency band  
in response to the output of the detection means only when  
the vertical edge is detected by the detection means.

2. A circuit according to claim 1, wherein said de-  
tection means detects the vertical edges from the lumi-  
15 nance signal.

3. A circuit according to claim 1, wherein said de-  
tection means detects the vertical edges from the lumi-  
nance signal and the color difference signal respectively  
and said signal restriction means is controlled by at  
20 least one of the results of both detections.

4. A circuit according to claim 1, wherein said re-  
striction means has the high suppress characteristic in  
which the passing of signal components whose frequencies  
are equal to and higher than a predetermined frequency  
25 are suppressed or restricted.

1        5. A circuit according to claim 2, wherein said re-  
striction means has the high suppress characteristic in  
which the passing of signal componetns whose frequencies  
are equal to and higher than a predetermined frequency  
5 are suppressed or restricted.

6. A circuit according to claim 3, wherein said re-  
striction means has the high suppress characteristic in  
which the passing of signal components whose frequencies  
are equal to and higher than a predetermined frequency  
10 are suppressed or restriceted.

7. A circuit according to claim 1, wherein said  
detection means detects the vertical edges from the difference  
between the signals which are read out during the same  
horizontal scanning period from the picture elements  
15 arranged in the two lines adjacent with each other in  
vertical direction on the imager.



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FIG. 1

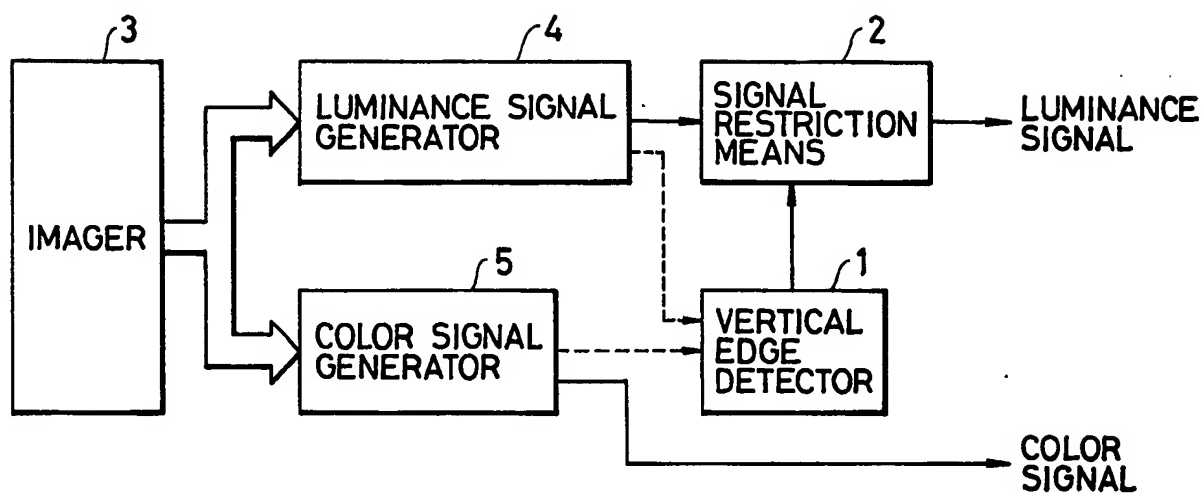


FIG. 2A

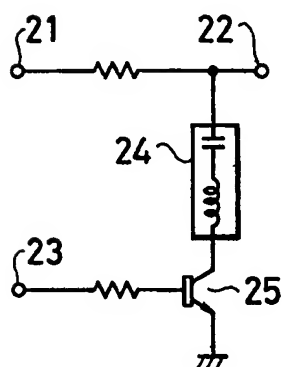


FIG. 2B

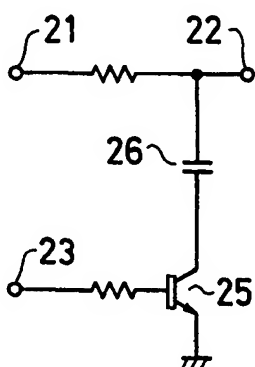


FIG. 2C

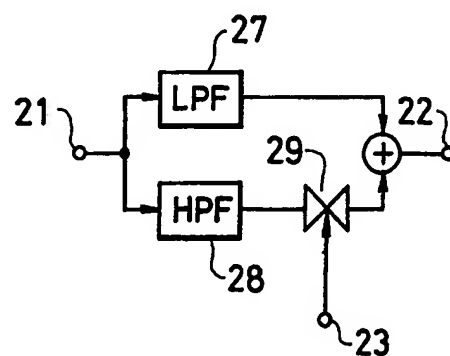


FIG. 3A

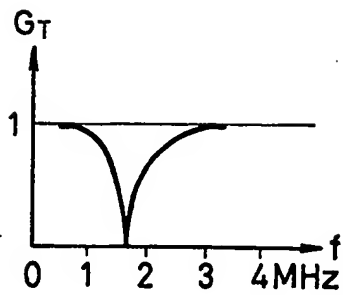


FIG. 3B

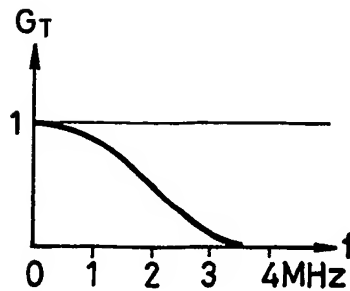


FIG. 3C

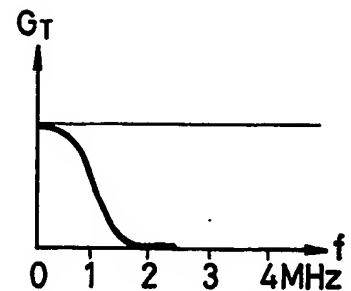


FIG. 4

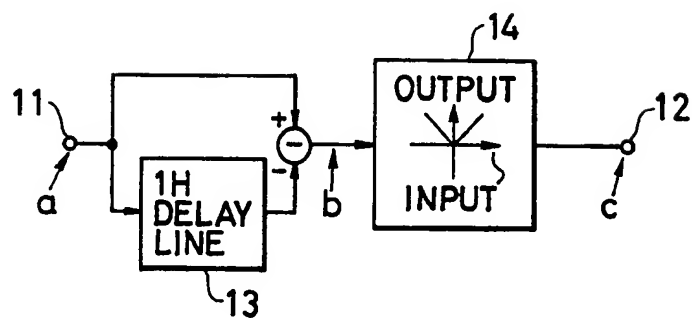
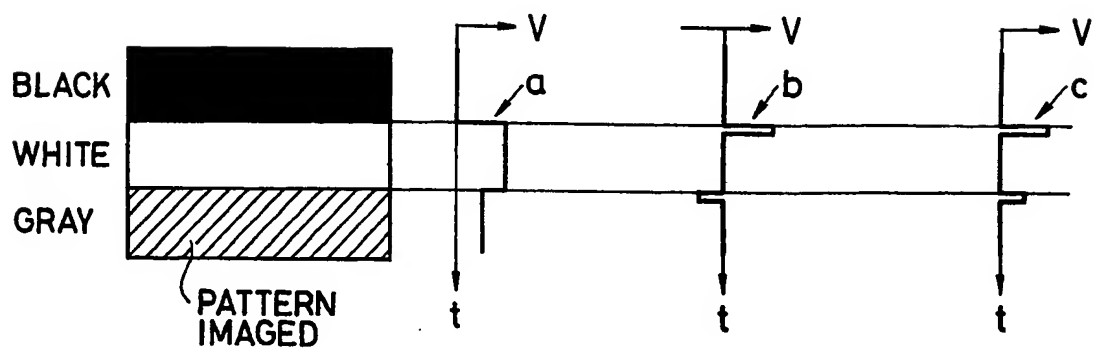


FIG. 5



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FIG. 6  
PRIOR ART

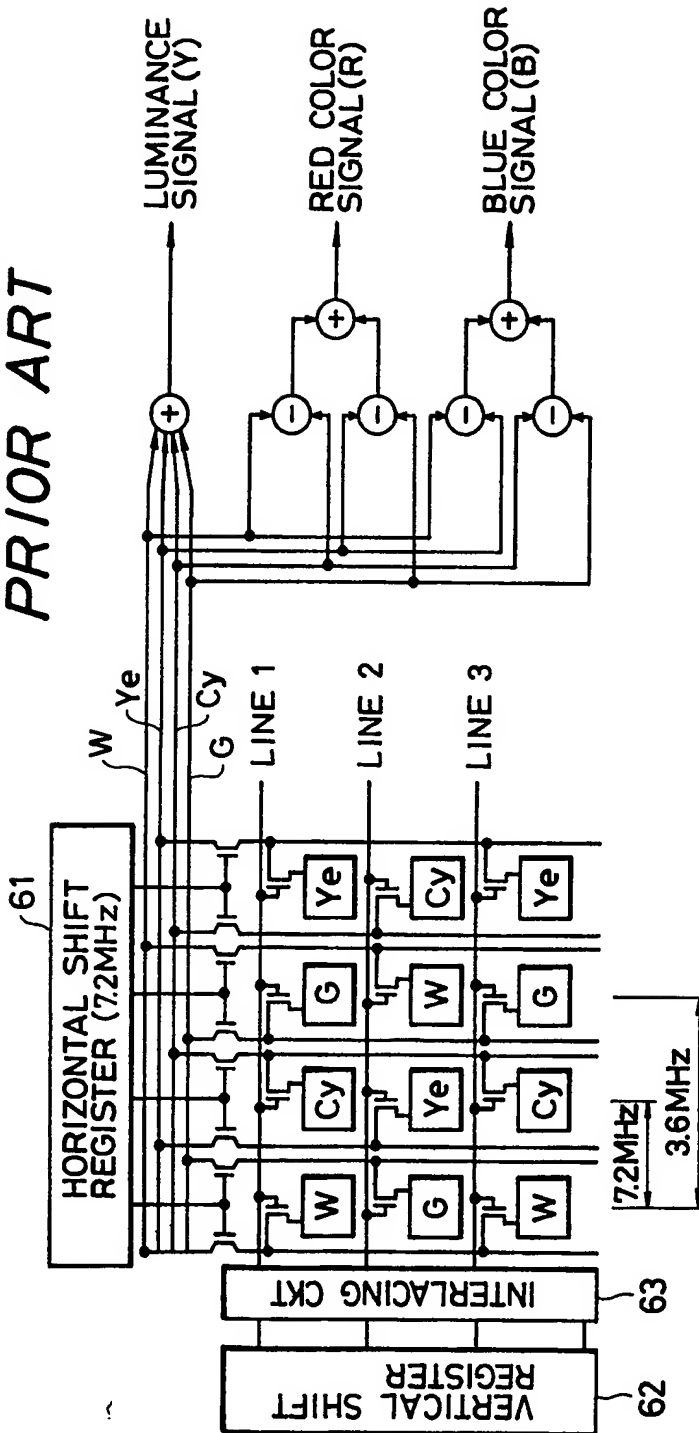


FIG. 7

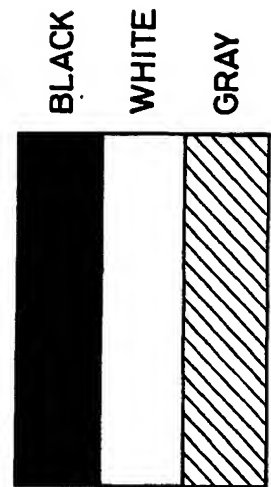
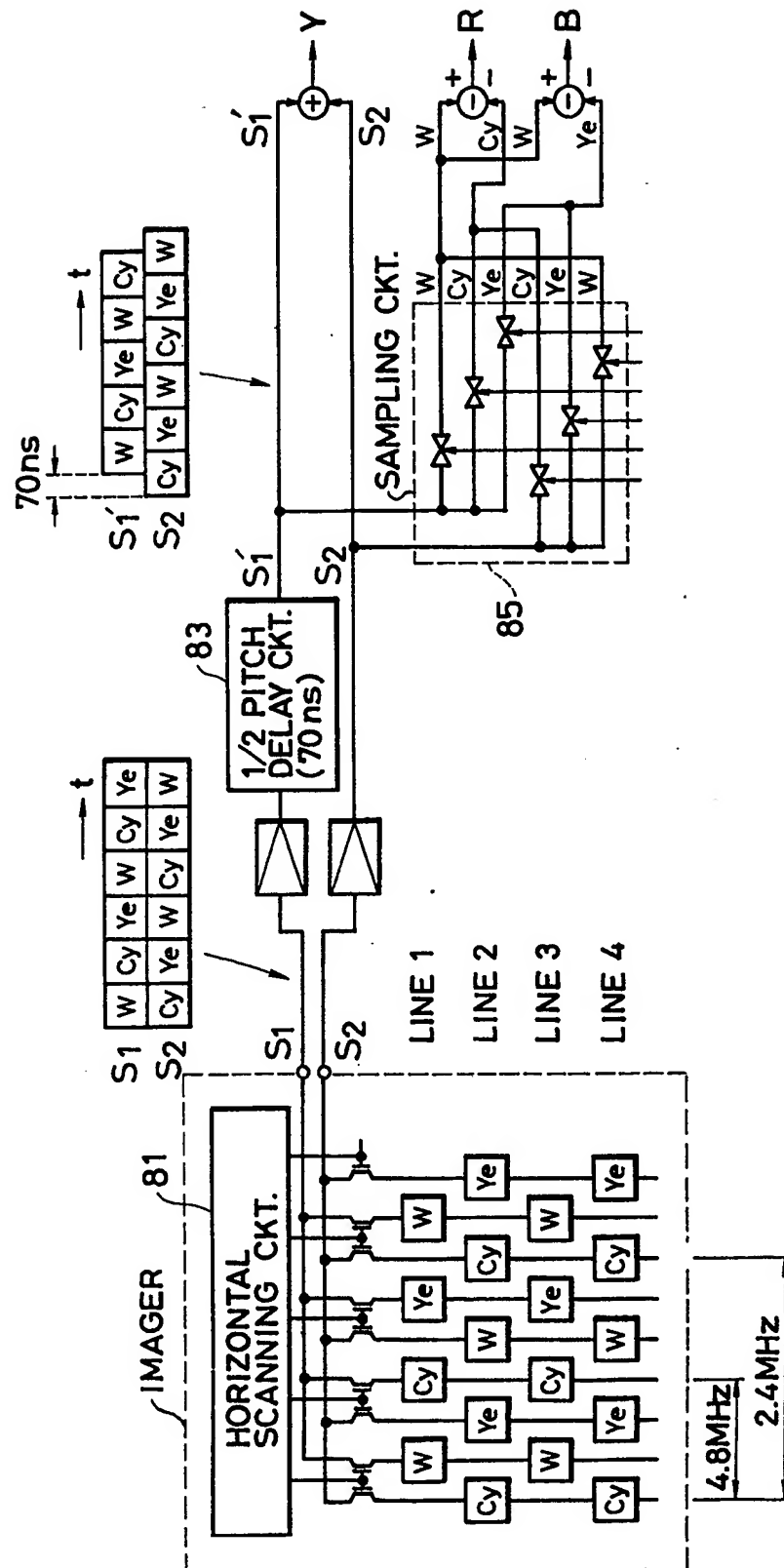


FIG. 8  
PRIOR ART





DOCUMENTS CONSIDERED TO BE RELEVANT			EP 85110810.0
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	<u>GB - A - 2 000 937</u> (EASTMAN KODAK) --		H 04 N 5/14 H 04 N 9/64
A	<u>GB - A - 2 005 511</u> (SONY) ----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			H 04 N 3/00 H 04 N 5/00 H 04 N 9/00
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 22-10-1985	Examiner BENISCHKA
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